Examples of Sustainable buildings and renovation projects from Greenland to Denmark

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Sustainable Buildings and Renovation Projects from Denmark and Greenland

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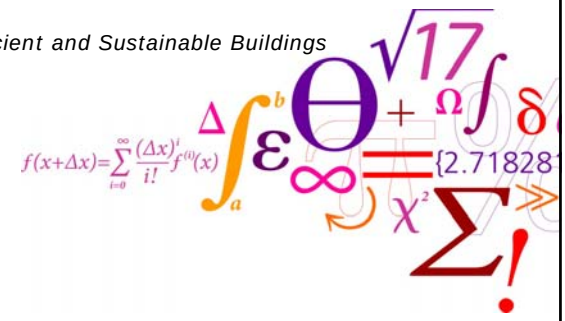
Workshop on *Energy Self-sufficient and Sustainable Buildings*
Brno University of Technology
April 6, 2009



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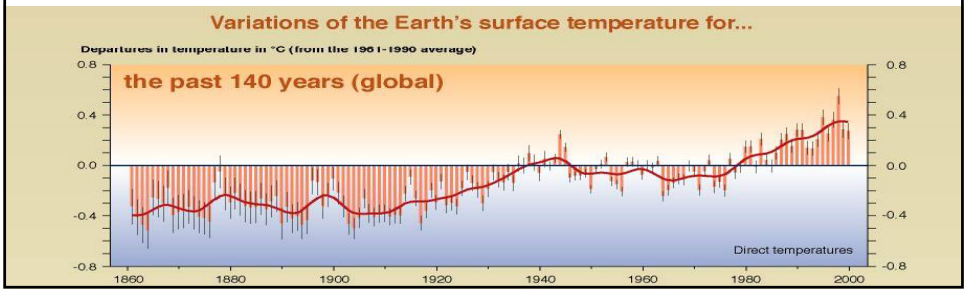
Institut for Byggeri og Anlæg

Drivers for EU policy within energy

- Security of supply
- Sustainability
- Competitiveness



Energistatistik

2007

ENERGI STYRELSEN

Development of GNP and the Gross Energy Consumption

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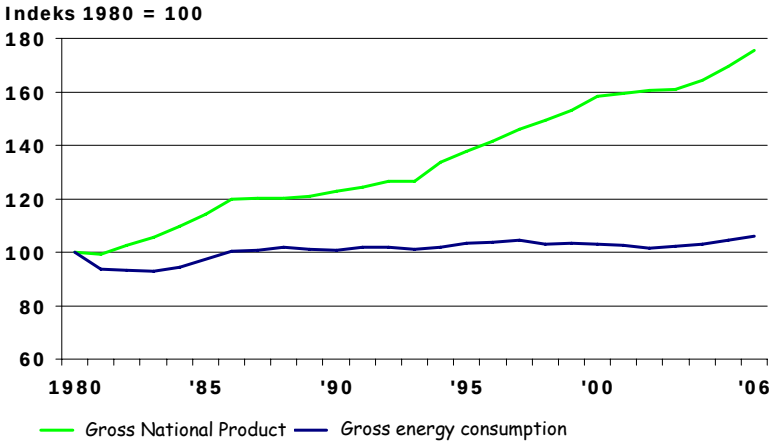

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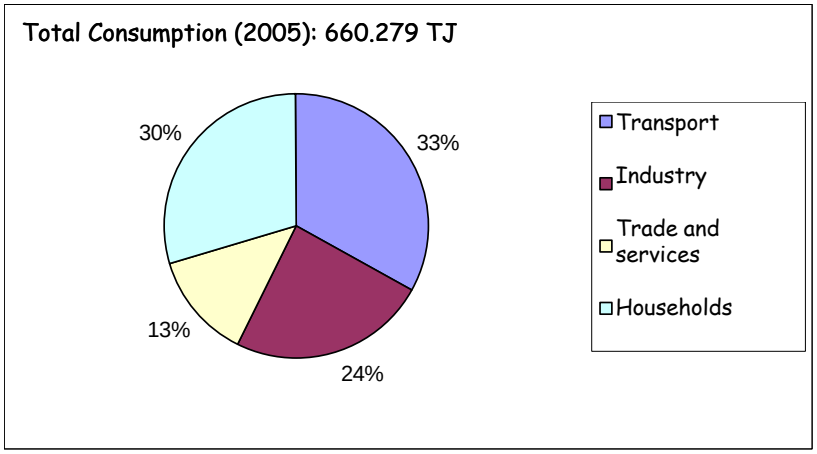
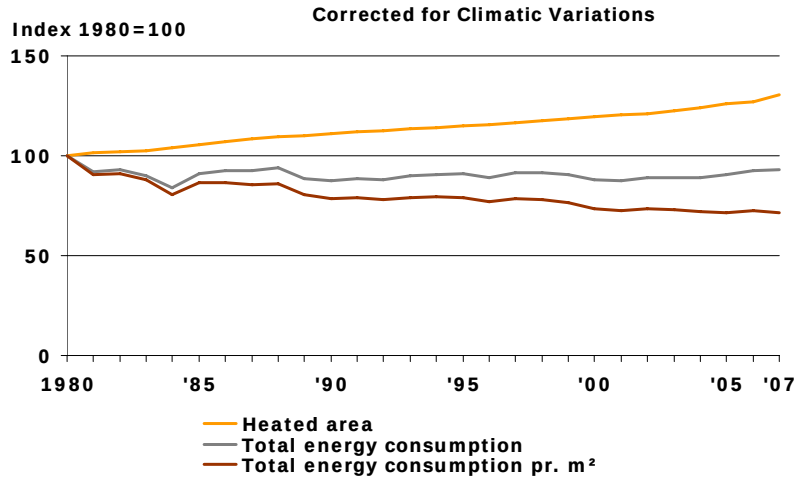
Distribution of the Energy Consumption - Denmark



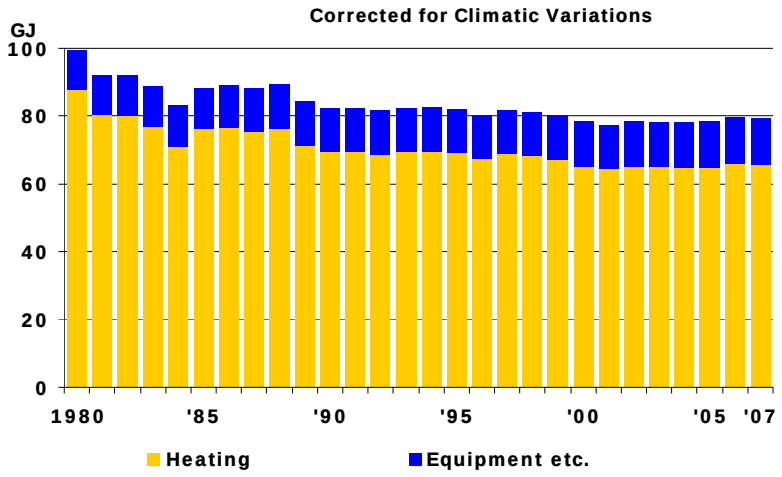
Household heating constitutes 27% of total energy consumption

Buildings in total: Approximately 40%

Energy Consumption for Heating of Dwellings



Energy Consumption pr. Household



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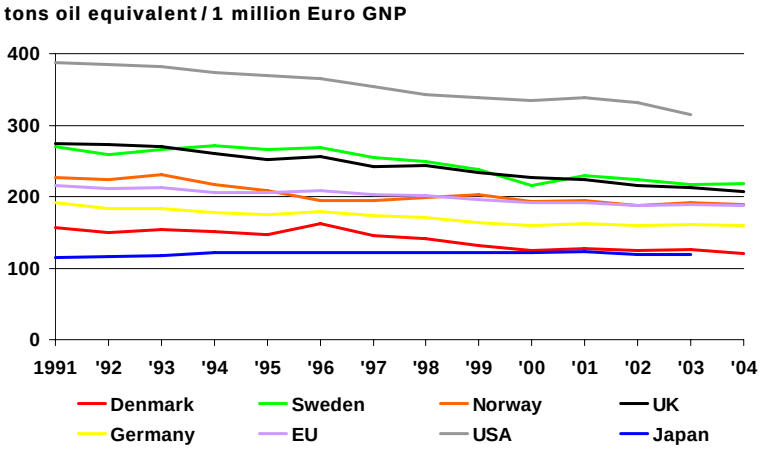
Gross Energy Consumption pr. GNP-unit in Selected Countries



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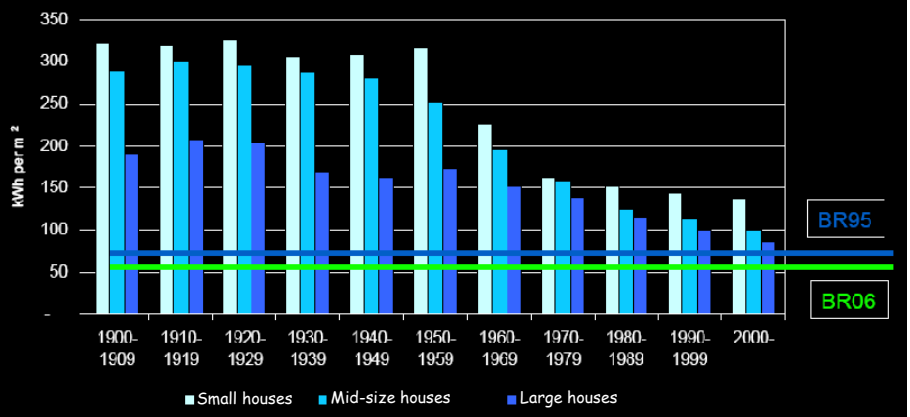
Energy use within EU

- **33%**
  - of all energy in EU is used for **transport**
- **26%**
  - of all energy in EU is used by **industry**
- **41%**
  - of all energy in EU is used by **buildings**
  - 66% is used for heating and cooling.
  - 80% of energy consumption is used in small buildings < 1000 m2

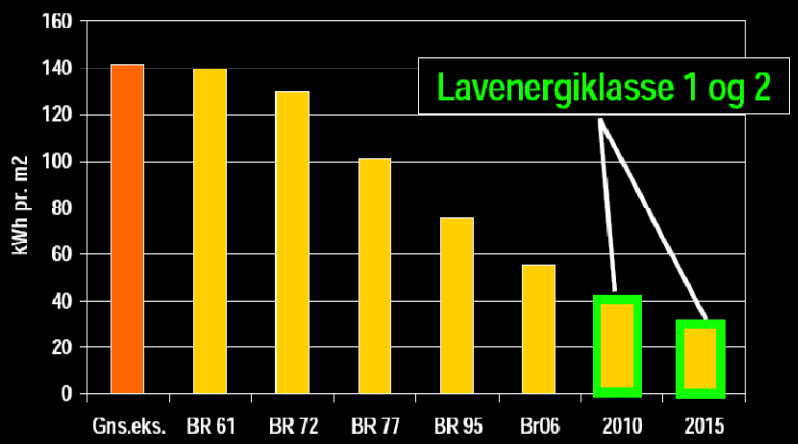
Energy Efficiency – First and Foremost

- Can be implemented immediately and with economic benefit
- Less heat consumption enhances security of supply
- Less electricity consumption reduces the need for new power plants
- Low energy construction suits wind power

Heat Consumption in Residences



The Danish Building Code



Danish Dwellings

- Old houses: 150-600 kWh/(m²·yr)
- BR 2006, Energy frame: (70 + 2200/Area) kWh/(m²·yr)
- BR 2010, Class 2: (50 + 1600/Area) kWh/(m²·yr)
- BR 2015, Class 1: (35 + 1100/Area) kWh/(m²·yr)
- BR 2020, Passive house: ("No heating system")

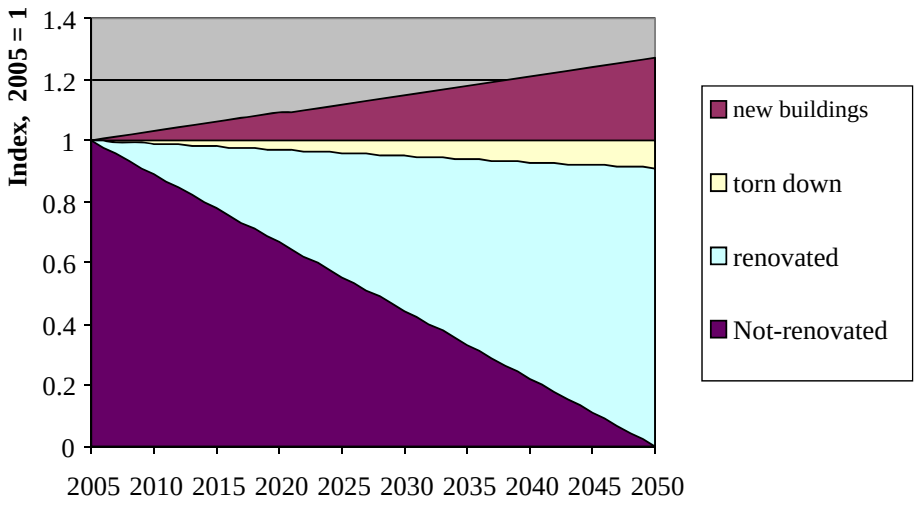
Danish demands - before, now, and in future

- 1979: Demands on amount of insulation
  - 75 % of building stock is from before 1979
- 2006: Energy frame
- 2010, 2015 og 2020: Tighter demands on energy
- Future: CO_2 frames?

Other European countries also do welll…

- Ambitions are also strong in Germany, Austria, the UK …
  - 8000 passive houses in Europe built with a good result

Development of the Building Stock in Denmark



Energy Renovation is More Important than Demands on New Buildings

- Building statistics shows:
  - New buildings do not replace existing buildings, but rather they come as an addition to the already built-up area

Energy vs. CO_2-emission

Energy form	CO_2 (kg/GJ)
Kul	95
Olie	74
Gas	59
District heating	Bio/co-generation/waste incineration
Electricity	District heating/ wind/nuclear

Thomas Herzog: *We are not running out of energy, we are running out of atmosphere*

DTU Climate Center

- Strengthen cross-going climate research at DTU
- 25 mio. kr. 2009-2011
- Lead by Risø DTU
- Contribution from 15 other DTU institutes
- DTU Byg: 1 Ph.D. and one senior researcher
  - Buildings as part of the energy system
    houses are not islands

Background:
COP15 – Climate Change Conference, Copenhagen Dec. 2009

Huses are not Islands

- **Energy system**
  - **Low temperature district heating** (now)
    - New technologies
    - New rules
    - Coupling to process heating
    - Coupling to local renewable energy production
  - **Local storage of energy** (to come)
    - Electrical cars
    - Fuel cells
- **Transportation**
  - Location of companies
  - The traffic system

New DTU Guest Residences

Research Needs 1

E2B JTI

- A more **efficient envelope:**
  - Improved materials
  - Bioclimatic architecture
  - Improved design, new concepts
- Better **equipment and systems**:
  - Efficient HVAC equipment
  - Electric appliances
  - Improved monitoring
  - Stronger systemic approach

Research Needs 2

E2B JTI

- Stronger integration of **renewable energies**
  - SolarPV
  - Solarthermal
  - Windturbines
  - Biomass
  - Geothermal
- Change collective and individual **behavior**
  - By harmonized EU regulations
  - Promotion of EE by public sector
  - Disseminate global costing, think long-term
  - Improve individual behavior

Experimental Building 0-energy House 1973

Demonstration Buildings: Low Energy Houses class 1 or Better

6 low energy houses built in 1979 in Lyngby with energy consumption for heating and hot water of 5000 kWh

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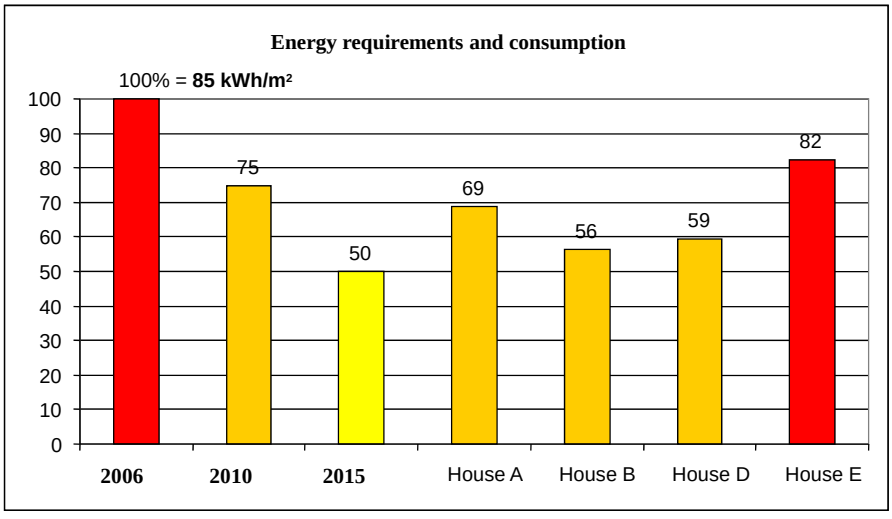
Inauguration of low energy house in Sisimiut, Greenland, April 2005

Type Houses Developed, Built and Measured

House	Location	Gross floor area [m²]	House type
A	Snekkersten	135	Detached, 1-storey
B	Lemvig	145	Detached, 1-storey
C	Hillerød	153	Detached, 1½-storey
D	Thyholm	88	Row house, 1-storey
E	Brøndby	133	Detached, 1-storey

Calculated Total Energy Consumption



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Examples:
Renovation of Lundebjerg in Ballerup

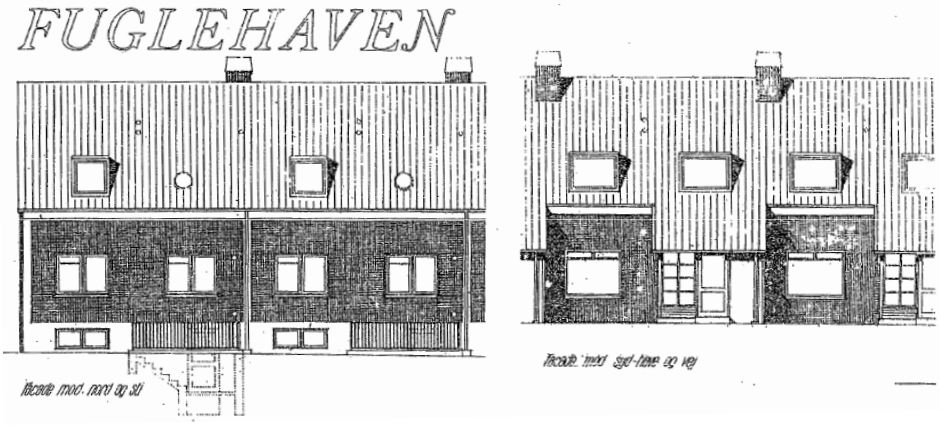
- Brick buildings from the 60'es with cold bridges in the outer wall
- Mould
- External renovation with new facade insulation system, new windows. In addition: A new ventilation system with heat recovery

Energy renovation

New windows:

Examples:
Renovation of Lundebjerg in Ballerup

Energy situation	Heat consumption, kWh / m²
Initial	**80**
Energy renovated	**46**
Energy renovated with heat recovery on ventilation air	**19**



- How to energy renovate best possibly and cheapest?
  - Insulation
  - Heat supply
  - Comfort, indoor climate
  - Architectural considerations
  - Rules and regulations
  - Common solutions vs. individually owned

Landskrona, Sweden
Passive houses med heating consumption 15 kWh/m²

Byggår 2004

Byggherre:
Landskronahem

Entreprenör:
Skanska

Projektledning:
Prime Project AB

Arkitekt: Mernsten
Arkitektkontor AB

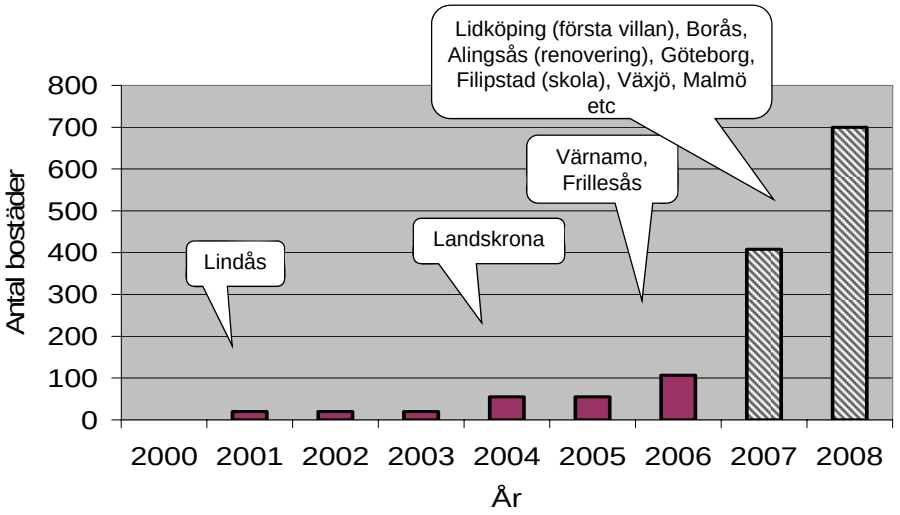
35 lägenheter

Hyresrätter; hyra ca 930 kr/m²år

Landskrona

Energieffektiva bostäder
Välisolerat klimatskal
Lufttät konstruktion
Mekanisk FTX > 80% återvinning
Luftvärme (el) 900 W/lgh
Varmvatten eluppvärmt
- Ekonomi i fokus!

Utvecklingen i Sverige af Passivhuse



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Danish/Nordic Passive Houses

- Click…
- What about Arctic…?

43 DTU Byg, Danmarks Tekniske Universitet Præsentation

LavEByg

Hvad er LavEByg:

- "Højtekn. netværk: Integrerede lavenergiløsninger på bygningsområdet"
- Støttes økonomisk af Forsknings- og Innovationsstyrelsen under MVTU

Hvem er LavEByg:

- BYG•DTU, DTU-MEK (ICIEE), AAU, SBi-AAU og TI
- Byggevareproducenter, rådgivende ingeniører, arkitekter, udførende, brancheorganisationer, andre faglige netværk, offentlige myndigheder

Hvad er LavEByg's formål:

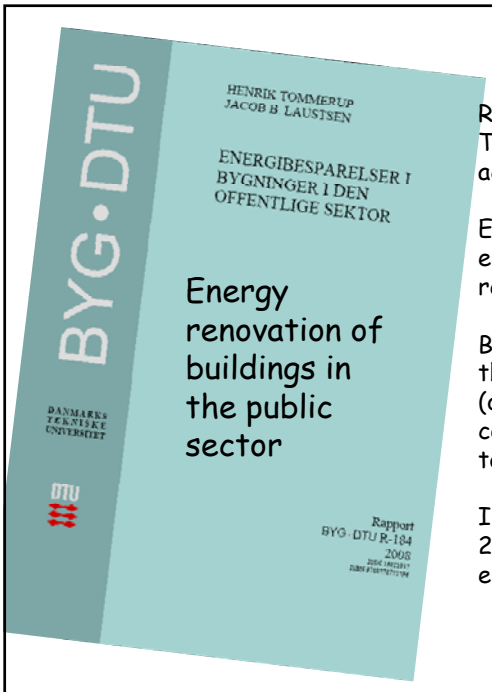
- Skabe varige samarbejdsrelationer mellem virksomheder og institutioner
- Udvikle konkrete fælles samarbejdsprojekter ml. virksomheder og instit.
- Øge anvendelsen af forskningsbaseret viden i byggeriet
- Erstatte en erfarings- og anvisningsbaseret byggebranche med en forsknings- og videnbaseret byggebranche
- ..og derved bidrage til at det store potentiale for energibesparelser ved nybyggeri og renovering realiseres

LavEByg

- LavEByg's overordnede aktiviteter:
  - Strategiudvikling
  - Matchmaking
  - Virksomhedsrettede ydelser
  - Formidling
- Fokus i 2008-09 er på Energirenovering af eksisterende bygninger (til lavenerginiveau)

LavEByg

- Netværket er åbent for nye deltagere, der ønsker at deltage aktivt i udviklingen af integrerede lavenergiløsninger – og særligt i relation til renovering !
- Yderligere information:
  - Svend Svendsen / Henrik Tommerup, BYG.DTU
  - LavE•BYG-netværkets hjemmeside: www.lavebyg.dk



Report shows:
There are considerable energy savings to achieve in public sector buildings.

Energy savings can be realized economically by stating more strict requirements in rules and regulations.

Based on analyses it is estimated that the energy savings potential is 15,9 PJ/yr (of which electricity: 3,7 PJ/yr) corresponding to 74 % savings compared to 2006.

Investment needs to make this before 2020 are 0,35 billion €/yr. The savings in energy consumption are 0.45 billion €/yr.

Measurements of energy consumption and indoor climate in a typical detached dwelling from the 1960/70'es, which has been thoroughly enegy reonavted, shows that big energy savings can be achieved, ands at the same time the indoor climate improved.

This is accomlished without compromising the architecural qualities.

For the specific house, and energy saving of 65 % was reached.

The potential for larger energy savings in Danish detached houses is considerable, since 45 % or appr. 500.000 of all 1,1 mio. Danish houses are from the 1960/70'es.

The energy saving measures are :

- Insulation of cavity walls (blowing in of appr. 80 mm insulation).
- Insulation of walls below windows/ behind radiators (75 mm).
- New extra window panes with energy (low-emission) glazing.
- Insulation of small attic (250 mm).
- Insulation of sloped wall (75 mm).
- Insulation of big attic (300 mm).
- Partially new radiators and thermostatic valves.

The renovation does not change the appearance of the house

Calculations:
The proposed renovations will reduce the design heat loss from 93 W/m^2 to 44 W/m^2, corresponding to 53 % reduction.

Also other expertises should be involved …

- Solar heating
- Building physics
- Building materials
- Building design and Architectural Engineering